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Studies on Permo-Trias of Madagascar. 4. Early Triassic Conchostracans from Madagascar

Abstract - *Euestheria (Magniestheria) truempyi* Kozur & Seidel, 1983 is here emended. It is characterized by minute reticulation sculpture on the growth bands and a serration margin of the growth lines. Genesis of serration structure is analyzed. Setose armature of the lines of growth is broken off and setae left their insertions which had formed serration margin along the growth lines for fossil conchostracans. Therefore, serration structure is not an important character for family Afrograptidae. In this paper the subgenus *Magniestheria* (emend.) is attributed to the family Euestheriidae, instead of family Afrograptidae in terms of type of sculpture. So far as we know this subgenus is the earliest representive for those having serration margin.

Euestheria (Magniestheria) truempyi Kozur & Seidel, 1983 was collected from the Lower Triassic (basal Olenekian) of Germanic basin and is here firstly reported in Gondwana. It may have lived in estuarine and ephemeral relict water bodies along a coastal line. The conchostracan-bearing beds represent regressive sediments during that time in Madagascar.

Key words: Conchostracans, Crustacea, Early Triassic, Madagascar.

Riassunto – Studi sul Permo-Trias del Madagascar. 4. Concostraci del Triassico inferiore del Madagascar.

Euestheria (Magniestheria) truempyi Kozur & Seidel, 1983 viene emendata nel presente lavoro. La specie è caratterizzata da una fine ornamentazione reticolare delle bande di accrescimento e dal margine seghettato delle linee di accrescimento. Viene analizzato lo sviluppo della struttura seghettata. La struttura setosa delle linee non è conservata rispetto alle inserzioni che formano un apparente margine seghettato lungo le linee di accrescimento per i concostraci fossili. Da questo si evince che la struttura seghettata non è un carattere essenziale per la tassonomia della famiglia Afrograptidae. Nel presente lavoro, il sottogenere *Magniestheria* (emend.) è attribuito alla famiglia Euestheriidae, invece che alla famiglia Afrograptidae in base al tipo di ornamentazione. Riteniamo che questo sottogenere sia il primo rappresentante di concostraci aventi margine seghettato.

Euestheria (Magniestheria) truempyi Kozur & Seidel, 1983 rinvenuto nel Triassico inferiore (Olenekiano basale) del bacino tedesco, viene ora segnalato per la prima volta nel Gondwana. Probabilmente viveva in estuari e in bacini lungo la linea di costa. Gli strati a concostraci riflettono sedimenti regressivi durante il Triassico inferiore in Madagascar.

Parole chiave: Concostraci, Crustacea, Triassico inferiore, Madagascar.

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Introduction

Fossil conchostracans are rare in Madagascar. Besairie (1952: 183) and Haughton (1963: 237) mentioned the existence of fossil conchostracans (*Estheria*), but undescribed yet. Tasch (1987) proposed that it might be of ?*Cyzicus* sp. These conchostracans were recorded in Bed 4 (Besairie, 1972), a shale-sandstone complex of the Upper Permian Lower Sakamena in south-western Madagascar. This unit has yielded reptiles, amphibians, fishes and some plants (*Glossopteris* sp.) etc. (Haughton, 1963). The Middle Sakamena (Bed 5) contains ammonites, fish remains and amphibians which are supposed to be indicative of an Eotriassic age. More recently fossil conchostracans of the Upper Cretaceous were found on this island which were assigned to Family Loxomegaglyptidae, based on large transverse reticulations of the growth bands (Chen Peiji, pers. com.).

Fossiliferous outcrops

The conchostracan sample studied in the present paper originated from Lower Triassic sediments in the Ambilobé area, NW Madagascar. These specimens are preserved inside sandy marl concretions rich in iron oxyde and associated with bivalves and gastropods. The Permotriassic succession (Besairie, 1972) in the region is in descending as follows:

6 Isalo continental sandstones
5 Upper Eotrias (*Flemingites* beds)
4 Middle Eotrias (fish and ammonite beds)
3 Lower Eotrias (*Claraia* and fish beds)
2 Neopermian (*Cyclolobus* and *Xenaspis* beds)
1 Neopermian (*Productus, Spirifer* and *Xenaspis* beds)

The conchostracan-bearing concretions were not collected from the section *in situ*. They are probably from Unit 4 based on lithologic characters, the stratigraphical outcrop in study area and geological age of the conchostracan species.

Euestheria (*Magniestheria*) *truempyi* Kozur & Seidel, 1983 was reported in the uppermost Bernburg Formation of the Germanic basin. The age of this species is lowermost Olenekian of the Lower Triassic. It is younger than *Claraia* beds and slightly older than *Flemingites* beds in Germany (Kozur & Seidel, 1983; Kozur, 1999; Kozur, pers. com.). As shown by Kozur & Mock (1993), the marine upper *Claraia* beds of late Induan age of Hungary contain in brackish intercalations *Cornia germari* (Beyrich), a spined conchostracan guide form of the upper Dienerian. Brackish intercalations in marine lower, but not lowermost Olenekian beds (middle Smithian) of Hungary contain *Euestheria (Magniestheria) mangaliensis mangaliensis* (Jones). In Germanic basin of Germany, *Euestheria (Magniestheria) mangaliensis mangaliensis* (Jones) occurs in a short lower Smithian interval between the *germari* fauna and the *mangaliensis* fauna. This allows for an accurate correlation with Unit 4 from the lowermost Olenekian of the Lower Triassic. So it is very important to find a species from northern hemisphere in Gondwana.

Fossil bivalves associated with these conchostracans (Cat. N° i11674 a, b) have been identified as *Bakevellia* sp. cf. *B. stockleyi* (Cox, 1936) (Fang Zhongjie, pers. com.). It is most ulike *Modiolopsis stockleyi* described by Cox (1936) in having their similar configuration. However, the examined specimens

show a front trance of posterior lamellar tooth, which allies them more closely with *Bakevellia* instead of *Modiolopsis* that is toothless on the valve.

B. stockleyi (Cox, 1936) was found from the marine intercalated beds of the upper part of Ruhembe beds in Kidodi area, Tanganyka and Sakamena beds of SW Madagascar. In Madagascar it lies somewhat below the bearing amphibian *Rhinesuchus* horizon which is an important element of the Early Triassic *Lystrosaurus* zone. Therefore, the bivalve-bearing beds are probably of Early Triassic age.

Systematics

Order Conchostraca Sars, 1867
Suborder Estheritina Kobayash, 1972
Family Euestheriidae Defrentin, 1965
Genus *Euestheria* Depéret et Mazeran, 1912
Subgenus *Euestheria* (*Magniestheria*) Kozur, 1982, emend. Shen *et al.*, 2002

Diagnosis: Carapace subcircular or oval in outline, small to moderate in size; growth bands ornamented with minute reticulations; growth lines with beading serration.

Discussion. All conchostracan specimens with beading serration are considered to be members of family Afrograptidae, which ranges from Jurassic to Early Tertiary in age (Chen & Shen, 1977, 1982, 1985; Shen & Chen, 1979; Chen & Hudson, 1991), including about 21 genera. Therefore, the afrograptideans demonstrate a variety of sculpture and structure of the valve and became a complex group. *Afrograpta* from the Lower Cretaceous of N Cameroun has three radiating costae in middle section on the valve and radial striae on the growth bands (Defretin, 1953; Novojilov, 1958). *Camerunograpta* from the Lower Cretaceous of Africa and Brazil possesses 12-16 radiating costae on the valve (Novojilov, 1958). The Lower Cretaceous *Migransia* of China is ornamented with simple radial striae sculpture on the growth bands (Chen & Shen, 1977). From the Upper Cretaceous of China, *Zhestheria* is ornamented by long and stout radial striae intercalated with 1-4 short lirae (Chen & Shen, 1977). *Dendrostracus* from Middle Jurassic of Scotland bears dendritic striae and small reticulations (Chen & Hudson, 1991).

The serration structure (setous armature or subtle setae) along lower margin of the growth lines can be seen in some species in three of five families of living conchostracans. One of these is the Indian taxon *Lynceus serratus* of the family Lynceidae, which possesses only one growth line (Royan & Alfred, 1971, fig. 1). The family Cyzicidae has more than 18 species with serration structure, such as *Cyzicus mexicanus* Claus from USA (Saunders & Shi-Kuei Wu, 1984, fig. 20), *Eocyzicus laiyangensis* Hu from China (Hu Weixing, 1985, fig. 2), *Caenestheria packardi* (Brady) from Sydney (Sars, 1896) and *Caenestheriella rubra* Daday from Madagascar (Daday, 1915, fig. 28) etc. The family Leptestheriidae has also at least nine species with setous armature, for example *Leptestheria kawachiensis* Ueno from China and Japan (Han & Shu, 1995, pl. 151, fig. 26), *Eoleptestheria spinorsa* from Yugoslavia (Marincek, 1978, figs. 1, 2) and *E. yanchowensis* from N China (Shu, Han & Liu, 1990, figs. 1-3).

Sars (1896: 23) indicated that in *Caenestheria packardi* (=*Estheria packardi*) «*...the setous armature of the lines of growth and of the free edges of the valve could be discerned, but the bristles gradually become shorter and partly broken off, so as at least, for the most part, only to leave their insertions...*». Thus it can be seen that these insertions had formed serration margin along the growth lines of these fossil conchostracans. Judging from this, the serration structure is not a very important taxonomic character for the family Afrograptidae, but it is considered as base for the classification of genera or even subgenera. Therefore, in present paper *E.* (*Magniestheria*) is attributed to the family Euestheriidae instead of the Afrograptidae based on its small reticulate sculpture. Obviously, it is the earliest representative for those taxa having serration margins.

The genus *Euestheria* (Reible, 1962) is worldwide in distribution, and ranges in age from the Triassic to Jurassic (Reible, 1962). It is dominantly ornamented with small reticulate sculpture on the growth bands, the diameter of mesh being about 0.015-0.02 mm. An important feature of the subgenus *Euestheria* (*Magniestheria*) (emend.) is that it possesses serrate margin except for small reticulations. Kozur & Seidel (1983) had originally not drawn their attention to this structure, but they agreed since it is clearly present in their specimens (Kozur, pers. com.). Thus, the specimens coming from Madagascar are attributed to the *E.* (*Magniestheria*) (emend.).

Kozur & Seidel (1983) placed the subgenus *Magniestheria* in the genus *Liograpta*, but the latter is ornamented with simple or dendritic radial linear on the growth bands. These are considerably different from those seen in the family Euestheriidae, in which small aligned reticulations appear in a few growth bands of the ventral part in the valve. In this respect the small reticulations of *Magniestheria* are closely allied to *Euestheria*, instead of *Liograpta*. Therefore, it is best referred to the genus *Euestheira*. *E.* (*Magniestheria*) is similar to *Aquilonoglypta* (reported in the Lower Triassic of Laptev, Russia and N China) (Novojilov, 1958: 49, pl. 4, figs 54, 54a; Wang & Liu, 1980, pl.120, figs. 2-6) in ornamentation on the growth bands, but the latter has fine horizontal reticulation and no serration structure. Sculpturing in *Magniestheria* is somewhat similar to that of *Polygrapta* (Navojilov, 1958), which ranges from Late Permian to Triassic, but the reticulations of the latter are transferred into incontinuous radial striae on the ventral part of the valve; also *Polygrapta* shows no beading structure.

Euestheria (*Magniestheria*) *truempyi* Kozur & Seidel, 1983, emend. Shen *et al.*, 2002
Plate I, figs. 1-10; Plate II, figs. 1-3

Geological age: Early Triassic.

Material: 54 individuals are preserved in four marl or sandy marl concretions (MSNM i11673, i11674, i11675, i11678). All specimens are internal or external molds, without chitinous layers.

Description. Carapace subcircular or oval in outline, moderate in size (6-13 mm in length); dorsal margin long and more straight, about 3/4 length of the carapace; small and elliptical umbo situated in anterior terminal end of the dorsal margin; dorsal side of the valve upheaved along the dorsal margin, forming a

groove in external mold of the valve; anterior margin arched, posterior margin rounded and ventral margin gently curved downward; anterior height greater than posterior; high h/l ratio >0.75; 16-26 growth lines stout; growth bands wide and convex, but narrow in the peripheral side, ornamented with minute polygonal and partly horizontal reticulations near antero-ventral and middle parts of the valve, line alignments appear the peripheral side; diameter of mesh being 0.007-0.008 mm; a few growth lines with beading serration along their lower margin.

Remarks. The specimens studied in this paper and type materials of the *Euestheria* (*Maguiestheria*) *truempyi* are identical in subcircular configuration, high h/l ratio and sculpture. Specimens from Madagascar possess very small reticulations on the growth bands and show beading structure along the growth lines. However, this species is similar to *Euestheria minuta* (Zieten), widely distributed in the Lower Triassic sediments (Reible, 1962; Zhang *et al*., 1976), in having oval shape and reticulations, but the shell of *Euestheria m.* is small in size, diameter of mesh about 0.002 mm and without serration margin.

Paleoecology

The chief habitat of both living and fossil conchostracans is fresh water, or sometimes brackish water, but never a normal marine environment. They generally live in small, temporary, inland ponds, flood-plain pools, roadside ditches, paddy fields, margins of big lakes, coastline, estuarine, lagoons and so on (Chen & Shen, 1985; Tasch, 1969). Some Paleozoic and Early Mesozoic conchostracans appear to be closely related to brackish environment. For example, *Phymolimnadiopsis* (Shen & Zhu, 1990) was found from the Early Permian Tungtzeyen Formation in Fujian, SE China, which comprises alternating thin beds of grey to dark grey, fine-grained quartz sandstone and siltstone, interbedded with mudstone and coal beds. This formation contains flora, bivalves, brachiopods, ammonoids, crinoids and decapod crustaceans. The conchostracan *Phymolimnadiopsis* is associated with *Lingula* sp. and the bivalve *Palaeoneilo* sp. on the same bedding plane. In SW China the conchostracans (*Palaeolimnadia* spp., *Euestheria* spp.) are known from Early Triassic Feixianguan Formation (Induan), which is composed chiefly of marine sediments with bivalves *Claraia*, *Eumorphotis* and ammonoids etc., and are also associated with *Lingula* and brackish bivalves (Zhang et al., 1976). The presence of conchostracans in the Feixianguan Formation indicates that the sea level had changed previous to that time. These conchostracans inhabited in quiet and shallow water, probably a non-tidal nearshore environment. *Limnestheria* of the Kilkenny Coal Measures of Ireland was found in the almost black carboniferous shales that grade downward into so-called "fleck-rock" which grades laterally eastward into marine shale. An ancient delta is suggested by these relationships and the conchostracan fauna is thought to have lived in an estuarine environment (Wright, 1920). On these bases we argue that the conchostracan *Maguiestheria* may have lived in estuarine and ephemeral relict water bodies along a coastal line. In Hungary, *Euestheria* (*Maguiestheria*) *mangalicusis mangalicusis* is very common in brackish intercalations of marine Werfen Beds with lower Olenekian conodonts (Kozur & Mock, 1993). Also in the Germanic Basin, the mass occurrences of this species from the Volpriehausen Formation at Baalberge (Kozur & Seidel, 1983)

are from beds with rich acritarch associations which indicate brackish influence of these beds (Kozur, pers. com.). The conchostracan-bearing beds reflected the regressive sediments during that time in Madagascar.

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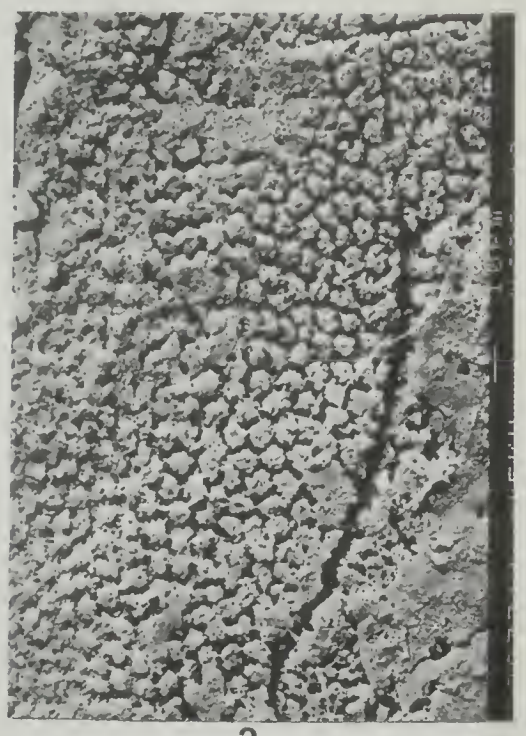
Plate I – Figs. 1-10 - *Euestheria* (*Magniestheria*) *truempyi* Kozur & Siedel, emend. 1) External mold of the right valve, x4, Cat. no. MSNM i11673b-1; 2) external mold of the right valve, x4, Cat. no. MSNM i11673b-2; 3) external mold of the left valve, x2,5ca., Cat. no. MSNM i11673a-8; 4) external mold of the right valve, x2,5ca., Cat. no. MSNM i11673a-6; 5) external mold of the left valve, x2,5ca., Cat. no. MSNM i11673a-7; 6) external mold of the left valve, x2,5ca., Cat. no. MSNM i11673a-5; 7) external mold of the left valve, x2,5ca., Cat. no. MSNM i11673a-6; 8) external mold of the left valve, x2,5ca., Cat. no. MSNM i11673a-4; 9) external mold of the right valve, x2,5ca., Cat. no. MSNM i11673a-3; 10) internal mold of the right valve, x4, Cat. no. MSNM i11675a-11.

Tavola I – Figg. 1-10 - *Euestheria* (*Magniestheria*) *truempyi* Kozur & Sidel, emend. 1) modello esterno della valva destra, x4, n. cat. MSNM i11673b-1; 2) modello esterno della valva destra, x4, n. cat. MSNM i11673b-2; 3) modello esterno della valva sinistra, x2,5ca., n. cat. MSNM i11673a-8; 4) modello esterno della valva destra, x2,5ca., n. cat. MSNM i11673a-6; 5) modello esterno della valva sinistra, x2,5ca., n. cat. MSNM i11673a-7; 6) modello esterno della valva sinistra, x2,5ca., n. cat. MSNM i11673a-5; 7) modello esterno della valva sinistra, x2,5ca., n. cat. MSNM i11673a-6; 8) modello esterno della valva sinistra, x2,5ca., n. cat. MSNM i11673a-4; 9) modello esterno della valva destra, x2,5ca., n. cat. MSNM i116743a-3; 10) modello interno della valva destra, x4, n. cat. MSNM i11673a-11.

1



2

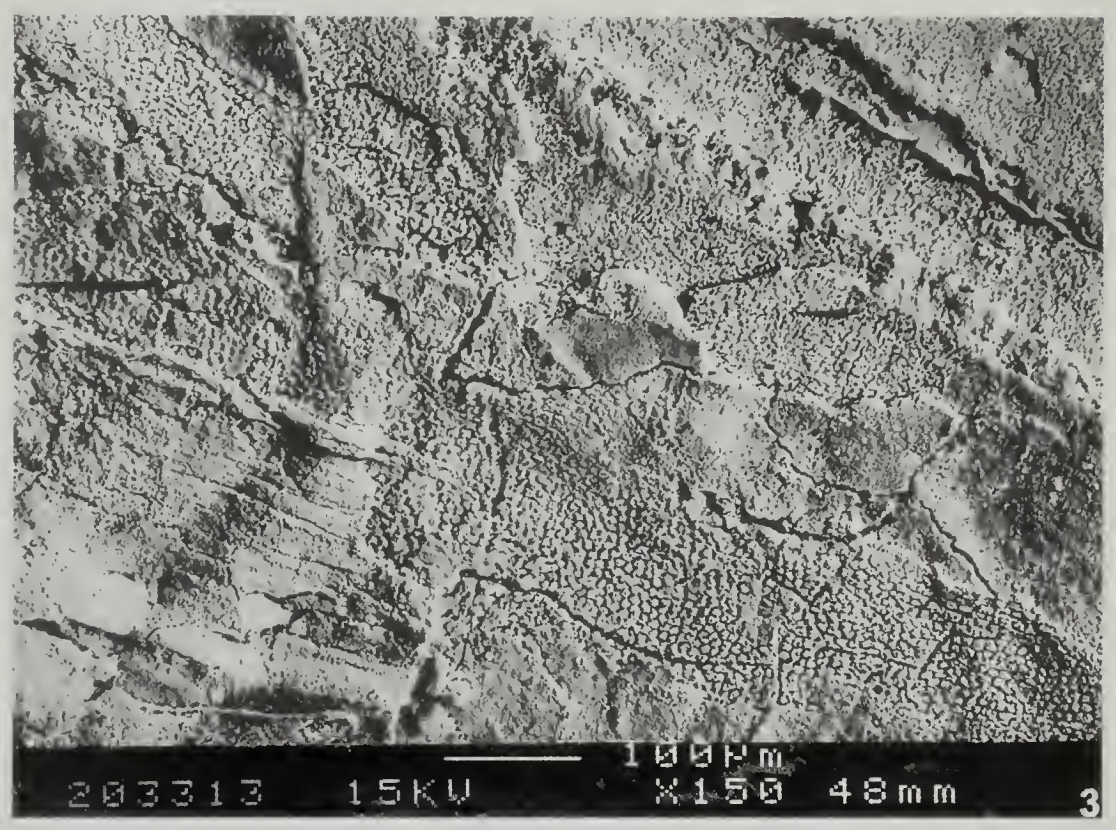


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Plate II – Figs. 1-3 - *Euestheria* (*Magniestheria*) *truempyi* Kozur & Seidel, emend. 1) Showing serration margin of the growth lines, x80, Cat. no. MSNM i11673a-10; 2) showing minute reticulations, x400, as for fig. 1; 3) showing minute reticulations on the growth lines and beading serration structure, x150, as for fig. 1.

Tavola II – Figg. 1-3 - *Euestheria* (*Magniestheria*) *truempyi* Kozur & Sidel. emend. 1) margine seghettato delle line di crescita, x80, n. cat. MSNM i11673a-10; 2) sottile reticolazione, x400, come per Fig. 1; 3) sottile reticolazione delle bande di crescita e struttura seghettata con ornamentazione imperlinata, x150, come per fig. 1.